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TENTATIVE BITUMINOUS-AND LIGNITE-MINE INSPECTION STANDARDS

REVISED SEPTEMBER 1943

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

TENTATIVE BITUMINOUS AND LIGHTNITE MINE INSPECTION STANDARDS[1/]

Revised September 1943

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INTRODUCTION

These inspection standards have been prepared for use in the Federal inspection of bituminous and lignite mines. They are a revision of "Tentative Coal-Mine Inspection Standards," published as Bureau of Mines Information Circular 7204 in February 1942 and employed as a guide for Federal inspections. Numerous changes have been made in the original standards owing in part to recognition of shortages of some types of safety equipment due to the war, in part because of need of additional standards to cover certain mine conditions and practices, and in part to conditions not foreseen when the original standards were prepared.

About one-fourth of these standards are marked with an asterisk (*) as being of particular importance in preventing accidents in many coal mines; however, failure to carry out the suggestions made in such of the other standards as are applicable may also lead to the loss of lives.

With continuing change in mining methods, some of these standards may become inapplicable, and further revision will be advisable. Therefore, questions regarding these standards and suggestions regarding new standards should be brought to the attention of the Bureau so that changes may be made from time to time. Numerous changes proposed by mine operators and by State mining departments have been incorporated in these revised standards.

In many respects these standards exceed the provisions of the various State mining laws, and some may conflict with the laws or safety orders of some States. In cases of conflict, the intent is not to advocate noncompliance with State laws but to suggest reconsideration of such laws or safety orders.

Although an effort has been made to word these standards so that they may be readily understood, nevertheless a reasonable interpretation should

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be placed upon them. In numerous cases the words "reasonable", "suitable", and "properly" are used in recognition of the fact that reason and sound judgment are vital in carrying out safety endeavor.

Any unusual hazard noted by an inspector and not covered by these standards will be discussed in the inspection report and effort made to offer suitable recommendation.

SURFACE CONDITIONS

01. Tipple or Cleaning Plant

01. To minimize fire and coal-dust-explosion hazards:

a. Electric motors used in tipples and cleaning plants should be dustproof.

b. All switches and starting boxes should be enclosed.

c. Stoves or other heating devices should be properly and safely installed and of a type to meet these purposes.

*d. Thorough cleaning of coal dust from the tipple should be done frequently and, if possible, daily. If it is impracticable to remove coal dust from remote places, such places should be rock-dusted.

*e. Coal dust should be allayed with water or other wetting agent at points where large quantities of dust are released, or a dust-collecting system should be installed at such points.

*f. Where coal is dumped at or near air intake openings, provision should be made to prevent the dust from entering the mine.

g. Coal dust should be kept from accumulating in or about any surface building.

02. Men working in or about tipples or cleaning plants should:

*a. Wear goggles if exposed to the hazard of flying particles.

*b. Wear suitable approved respirators when working in dusty atmospheres.

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03. Welding in tipples or cleaning plants should be done preferably when the plant is idle; welding should not be done in a dusty atmosphere; a fire extinguisher should be readily available; and combustible surroundings should be wetted down before and after welding.

*04. Where coal is treated with oil, men exposed to the oil mist should wear suitable approved respirators, and sources of ignition should be kept at safe distances from the oil spray.

02. Mine Refuse Disposal

01. Mine waste should be stored so as not to present fire, fume, or slide hazards.

02. The waste dump should be fenced where there is a possible hazard to persons, especially children, or to animals.

*03. Persons should not be permitted to live or work in buildings imminently endangered by fire, fume, or slide hazards from waste dumps.

03. Head Frame

01. A railed platform should be provided at head sheaves.

02. The stairway leading to the sheave platform should be provided with a handrail.

04. Hoisting

01. Machinery should be so placed that the noise from it will not prevent the hoisting engineer from hearing signals.

*02. Hoists should be equipped with brakes capable of stopping and holding the fully loaded unbalanced cage or trip of cars at any point in the shaft or on the incline.

03. Hoisting engineers should be physically fit and should undergo a physical examination at least annually to determine their continued fitness, and physician's report of such examination should be posted.

*04. Hoisting equipment should be inspected daily and a record made of such inspection.

05. Sheaves should be inspected daily and kept properly lubricated. The hoisting engineer should be advised when the inspection is completed,

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and a record made of this inspection. The hoist should not be operated during the inspection.

*06. A second engineer should be in attendance at all times while men are being hoisted or lowered, unless the hoist is equipped with automatic overwind and overspeed and automatic stop controls that are tested daily.

07. At the beginning of each shift, the hoisting engineer should operate the cages slowly up and down the shaft at least one round trip before hoisting or lowering men.

*08. An accurate and reliable indicator of the cage or trip position should be so placed as to be in constant view of the engineer.

09. Drum guides or flanges should be high enough to extend at least 4 inches above rope at any time.

10. A hoisting rope should be adequate in size to handle the load with proper factor of safety as defined in wire-rope standards.

11. The rope should make at least three full laps on the drum when extended to its maximum distance and should make at least one full lap on the drum shaft; the end should be fastened securely by means of clamps.

12. The rope should be fastened to its load by a spelter-filled socket, or by a thimble and clamps or clips.

13. Bridle chains that serve as a secondary safety connection between the rope and the cage should be provided.

14. A rope should not be used for hoisting men:

a. Which shows more than six broken wires in any single pitch length or lay of rope.

b. When the wires in the crown of the strand are worn to less than 65 percent of their original diameter.

c. When inspection indicates a dangerous amount of corrosion or distortion.

*15. A record should be kept of the length of service of, and tonnage hoisted by, all hoisting ropes, and ropes should be replaced as soon as there is evidence of undue weakness or other conditions which indicate that the rope may fail.

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*12. Ropes, links, chains, and rope sockets should be examined carefully at least every 24 hours by a competent person and a record kept of such inspections.

17. Rollers used on slopes or inclines should be of sufficient length, properly alined, and kept in good repair.

18. At least two independent methods of signaling, one of which should be audible, should be provided on all landings in shafts or slopes.

19. One of the signal devices at the surface and at each intermediate landing should be so located that it can be reached from the cage or car.

20. The signal code in use at the mine should be posted prominently in the engine room in easy sight of the hoisting engineer and at all places where signals are given.

8. Cages and Shafts

*21. Cages used for hoisting men should be of substantial construction, kept in good repair, and provided with:

*a. Adequate steel bonnets.

*b. Sides of cage fully enclosed.

*c. Gates across openings, when men are being hoisted and lowered.

*d. Handholds.

*22. Cage safety catches that act quickly and effectively in an emergency should be provided, and they should be tested at least every 2 months and a written record kept of the tests; where practicable, a drop test should be made.

23. Cages and shafts should be inspected daily and a record kept of such inspections. Guides should be maintained in good repair.

24. Any opening in the cage floor should be covered when men are handled.

*25. Wood-lined shafts should be timbered; if it is not practicable to timber all of them, adequate protection should be provided against falls.

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*06. A cager should be in charge at the top and bottom of the shaft when men are handled.

*07. Shafts should be equipped with safety gates at the top and at any intermediate landings. The gates should be so constructed that materials will not go through or under them and into the shaft.

08. Positive stopblocks or derails should be placed at shaft landings.

*09. Tools or other material should not be carried in the cage with men; however, this should not apply to equipment and material requiring attendants.

10. The speed of cage when hoisting or lowering men should not exceed 900 feet per minute.

11. A run-around should be provided for travel at the foot of shafts and at all intermediate landings. The run-around should not be less than 5 feet high and 3 feet wide.

12. While engaged in repair work in or above shafts, safety belts should be worn by all workmen. When a platform is being used, a second or safety platform should be placed not more than 10 feet beneath the working platform.

06. Steam and Compressor Plants

01. All boilers should receive at least one internal inspection annually by an authorized inspector, and a written record of such inspection should be kept.

02. A safety-valve escape should not discharge lower than 7 feet off the floor; preferably the discharge should be piped to the outside of the building.

03. At least two safe means of exit from all parts of the boiler room should be available, and the doors should open outward.

04. A stairway or fixed ladder should be provided to give easy access to the top of boilers or runways between boilers.

05. A fusible plug that will open at a temperature of 50° less than the flash point of the lubricating oil in use should be placed in the main discharge line of compressors and as near the compressor as possible.

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06. Main compressed-air receivers should be equipped with safety or relief valves.

07. Compressed-air receivers should be inspected at least annually by a competent person, and a written record of such inspection should be kept.

08. Suitable gages should be provided for boilers and compressors (steam pressure, air pressure, water, etc.).

07. Wash Houses

01. If practicable, wash houses should be provided and should be:

a. Provided with showers and an adequate supply of hot and cold water.

b. Kept clean and sanitary.

c. Provided with at least two exits.

d. Well-illuminated.

e. Provided with clothes lockers or hangers.

f. Kept well-heated and, if necessary, heating equipment guarded against contact hazard.

g. Properly ventilated.

h. Provided with adequate facilities to prevent the spread of foot infection. If foot baths are used, the disinfectant should be changed daily.

i. Provided with sanitary toilet facilities.

08. Supply Houses

01. Material should be stored so that it will not fall or cause a stumbling hazard.

02. Oil and grease should be stored in closed containers separate from other materials and in such manner as to not create a fire hazard.

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03. If oil or grease is stored in a building, the building should be of fire-resistant material and provided with a ventilator extending to near the floor level.

09. Lamp House

01. Charging equipment should be guarded and protected against shock and fire hazards.

02. Naphtha used for flame safety lamps should be stored in suitable containers.

*03. Flame safety lamps should be of a permissible type.

*04. Flame safety lamps should be properly cleaned and assembled by a lamp attendant after each period of use. Lamp assembly should again be thoroughly checked by the person using it immediately before he enters the mine.

05. When not in service, all methane indicators or detectors and flame safety lamps should be placed in the custody of a competent person responsible for their maintenance and testing.

10. Yards and Material Storage

01. Timbers, ties, and other mine lumber, other than 1 day's supply, should not be kept within 100 feet of any mine opening or mine fan, and all materials, including rails and scrap iron and other scrap, should be properly stored and piled so that they will not obstruct roadways, will not present stumbling hazards, and will not roll or fall.

02. Roads, paths, and walks should be kept free from obstructions and should be well-illuminated if used by night shifts.

11. Surface Fire Protection

*01. All buildings within a radius of 100 feet of mine openings should be of fireproof or fire-resistant construction. If existing buildings within 100 feet of openings are not of fireproof or fire-resistant construction, fire doors should be erected at effective points (in shafts, drifts, or slopes) where smoke or fire from outside sources may endanger men working underground. These doors should be tested at least every 3 months to assure effective operation.

*02. Adequate fire protection should be provided. Fire-fighting equipment should be readily accessible, and the location of such equipment plainly marked.

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33. In the event municipal fire-department facilities are available, fire-hydrant couplings should be standard and interchangeable with those of municipal fire departments, or suitable adapters should be provided.

*34. Fire-fighting equipment should be inspected and tested at least every 3 months and a record made of such inspections.

35. A fire-fighting organization should be maintained and, if feasible, fire drills held at least four times a year.

36. Tight metal receptacles should be provided for oily waste.

*37. Smoking in or about surface structures should be restricted to places where it will not create a fire or explosion hazard.

16. Miscellaneous Surface Conditions

38. Good housekeeping should be practiced.

39. Surface buildings should be well lighted and heated, if necessary.

40. Surface stairways should not be set on an angle of more than 45° with the horizontal.

*41. Stairways should be provided with side handrails and kept in good repair.

42. The treads of stairways should present a minimum slipping hazard, and be of uniform construction and spacing.

43. Clearance over stairways should be at least 6-1/2 feet.

44. Permanent ladders should be provided with guards if necessary.

*45. Openings in floors should be provided with railings and a railing.

TIMBER METHODS, EQUIPMENT, AND MATERIALS

17. Timbering

*46. A record of systematic timbering should be plotted to scale each week and a weekly record of posts.

47. The timbering method should be strictly enforced.

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*03. Enough props, timbers, and prepared cap pieces and wedges should be provided convenient to the faces and other places of use.

*04. Miners and other face employees should examine their working places thoroughly and make them safe before beginning work.

05. Every underground worker should be instructed in the methods of testing roof, including the vibration method.

*06. Exposed roof in every active working face should be tested at frequent intervals.

07. Mining-machine and loading-machine operators should be provided with suitable roof-testing rods and should test the roof and sides; any dangerous condition should be remedied before taking the machines inby the last permanent timbers. Machines should be stopped while the roof and sides are being tested.

*08. Officials should test exposed roof in working places visited and roof along haulageways and manways with a special roof-testing rod; condition of timbering should also be observed.

*09. Loose coal, slate, or rock, in places where men are required to work or travel, should be removed or supported immediately following detection.

*10. Overhanging ribs or brows should be taken down or supported effectively.

11. Before taking down loose roof a careful examination should be made of the adjacent roof; if the conditions in any way warrant it, a temporary post or posts should be set first.

12. If loose slate or other roof material is being pried down a bar not less than 4 feet long should be used instead of a pick.

*13. Safety posts or cross bars should be set before coal loading is begun, and the tightening wedges should be inserted with the thin edges toward the face.

14. The roof should be examined carefully before safety posts or cross bars are removed and, where necessary, additional timbers should be set. If any safety posts are removed before additional timber is set, a long bar or rail rather than a hammer or ax should be used in removing posts.

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15. Where there is danger of coal rolling upon a person, after undercutting or center-cutting, it should be spragged by placing blocks in the cut not more than 4 feet apart or by blocking with leaning posts.

16. In slopes or inclined shafts and in the main haulageways, posts supporting the roof or sides should be hitched into the rib or wall. If this is not practicable, substantial guardrails should be placed along or spacers placed between the posts.

17. Posts should be set with adequate cap pieces and tightened by wedges between the posts and the cap pieces if necessary.

18. Cap pieces should be of adequate thickness and at least as wide as the top of the post. If practicable, they should be at least 18 inches in length and 3 inches or more in thickness. Preferably, prepared cap pieces should be provided.

19. In hand-loading places where permanent crossbars are required, temporary timbers should not be extended more than the distance of one "cut" of coal beyond the last permanent crossbar.

20. In mechanical loading places where temporary crossbars are required to be set close to the face, such temporary crossbars should not be removed until permanent crossbars or posts have been set to replace them; no more than two "cuts" of coal should be removed beyond the last permanent crossbar.

*21. Miners or other employees should not go under draw slate or other loose roof material until it is made safe.

22. Broken and rotten timbers should be replaced as soon as possible.

23. Timber removed by cutting-machine or loading-machine operators or timber knocked out by shooting should be replaced as soon as possible.

24. Timbers should be recovered from worked-out sections only by mechanical means, by men experienced in such work, and under the direct supervision of an official.

25. In pillar work, breakline posts or cribs should be maintained at the loose ends of pillars and stumps.

14. Explosives and Blasting

01. Surface magazines should be provided for the storage of explosives and detonators.

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02. Surface explosives-storage magazines should be:

a. Constructed of incombustible material or covered with fire-resistant material and be reasonably bulletproof.

b. Located in accordance with the American Table of Distances insofar as feasible, and be not less than 200 feet from any mine opening or vital structure.

c. Located a safe distance from waste dumps.

d. Provided with suitable danger signs nearby.

e. Provided with proper ventilators effectively screened.

f. Provided with proper doors.

g. Kept locked securely at all times when not being used.

h. On suitable drained locations.

03. If the explosives magazine is illuminated electrically, the lamps should be of vaporproof type, the switch should be located outside the building, and wiring should be in conduit.

04. The area surrounding the magazine for not less than 25 feet, preferably 50 feet, in all directions should be kept free of rubbish, dry grass, or other material of a combustible nature; preferably, this area should be covered with some material to prevent the growth of grass, brush, and weeds.

05. Detonators should be stored in a separate magazine of incombustible material or the magazine covered with fire-resistant material and located not less than 100 feet unbarricaded, or 50 feet barricaded, from a magazine containing explosives.

06. Detonators, tools, or materials other than explosives should not be stored in an explosives magazine; however, this does not prevent the storing of safety fuse or detonating fuse (used for outside blasting) or blasting supplies in any explosives or detonator magazine.

07. Magazines for distributing explosives or detonators should be of the same type of construction as storage magazines and situated not less than 200 feet from any mine opening or vital structure.

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08. Not more than 1 day's supply of explosives should be kept in a distributing magazine.

09. Unauthorized persons should not be permitted in any magazine.

10. Only hardwood or nonsparking plastic tools should be used for opening containers of explosives and detonators.

11. Waste paper and empty boxes should not be allowed to accumulate in explosives or detonator magazines.

12. Smoking, and carrying matches and smokers' articles, open lights or open flame should not be allowed in or near any magazine, or while explosives or detonators are being handled.

13. Containers of explosives or detonators should always be lifted and set down carefully, never slid over one another or dropped from one level to another.

14. Deteriorated or damaged explosives or detonators should be destroyed. Explosives and detonators should be destroyed only by a person who is experienced in this work, preferably a technical representative of a manufacturer of explosives.

15. A Cardox charging station should:

a. Be located in a fireproof structure on the surface.

b. Be located in a detached building or isolated from other operations in the same building by a substantial fireproof partition.

c. Have all electric equipment grounded.

d. Have permanent storage tanks at least 200 feet from any mine opening, preferably at a lower elevation.

e. Be provided with at least two methods of relieving excess pressure in the storage tank. If one of these methods is a valve, the valve should be tested monthly.

f. Have a box-type magazine for storing the daily supply of heater elements.

16. A separate magazine should be provided for the storage of Cardox heater elements; it should be constructed of incombustible material or covered

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with fire-resistant material and be not less than 100 feet (if unbarricaded) or 50 feet (if barricaded) from other buildings.

17. Vehicles used in surface transportation of explosives should be constructed substantially, have tight bodies with no internally exposed metal, and kept in good working order. Open vehicles should be provided with tarpaulins. The ends and sides of the vehicles should be high enough to prevent containers from falling or rolling off.

18. State or other regulations as to marking vehicles transporting explosives should be followed. If no laws or regulations are in effect, any such vehicle should be placarded on each side and rear with the word EXPLOSIVES in letters not less than 3 inches high or should display a red flag with the word DANGER in white letters not less than 6 inches high.

19. Unauthorized persons should not be permitted to ride on vehicles transporting explosives, and the driver and helper should neither smoke nor carry matches or lighters.

20. A vehicle containing explosives should never be left standing or unloaded without first stopping the motor and setting the brakes securely and should never be taken into a garage or repair shop. Explosives cases should never be left immediately back of the exhaust, as a spark may start a fire or cause an explosion.

21. Explosives or detonators should never be left unattended until they are placed in a magazine and the magazine is locked or are delivered to someone authorized to receive them.

22. Records should be kept of all explosives and detonators received, stored, and used.

*23. Individual boxes (such as wood, plastics, or pressed fiber) or receptacles (such as rubberized or leather bags) used to carry explosives or detonators into mines should be closed and constructed substantially of nonconductive material and maintained in good condition.

24. When explosives and detonators are transported underground by locomotive, rope, or belt:

*a. They should be specially designed cars or in specially designed containers.

(1) The bodies of such specially designed cars should be constructed substantially of nonconductive material

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and should be fully insulated. Insulated couplings should be used to complete full insulation if necessary. When cars contain explosives or detonators they should be locked or attended at all times.

(2) Specially designed containers should be of wood approximately 2 inches in thickness; they should be fully insulated, and locked securely when not attended.

*b. If they are hauled in the same explosives car or in the same specially designed container, they should be separated by at least a 4-inch substantially fastened wood partition or the equivalent.

26. When feasible, the supply of explosives should be delivered on the off shift or between shifts.

*27. Explosives or detonators should not be carried on the same trip with workmen.

*27. Trips carrying explosives should not be hauled into or out of a mine within 8 minutes preceding or following man-trips; when traveling with the air current, the explosives trip should precede; if against the air current, the man-trip should precede.

28. Explosives and detonators for use at working faces should be stored in individual containers in niches in the rib not less than 10 feet apart and at least 100 feet back from the working face; not more than 1 day's supply should be stored in these locations. In pillar or stump work or in places where it is not practicable to cut niches in the rib for storage of explosives, the foreman should designate safe places where explosives may be stored.

29. If underground operation boxes or magazines are provided, they should be:

a. Placed in a crosscut or abandoned room neck at least 50 feet from roadways and trolley or power wires, and in a comparatively dry place.

b. Kept locked at all times except when in use.

c. Protected from falls of roof.

d. Constructed substantially and, if of metal, with electrically nonconducting lining.

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30. When operation boxes or magazines are used the explosives and detonators should be kept preferably in separate boxes or magazines. If kept in the same box, they should be separated by at least a 4-inch substantially fastened wood partition, or the equivalent.

31. No more than a 24-hour supply of explosives or detonators, including any surplus remaining from the previous day, should be stored underground. To avoid deterioration of explosives, the older explosives should be used first.

*32. All explosives used in underground coal mines should be of permissible type. Permissible explosives should be used as follows:

*a. Consist of not more than 1-1/2 pounds in any one shot.

*b. Fired only with electric detonators of proper strength.

*c. Fired with permissible shot-firing units.

*d. Not be fired on the solid unless it is impossible to cut the coal.

*e. Stemmed with incombustible material.

33. Shots should be charged and fired by certified shot firers, other certified officials, or authorized persons.

34. If physically possible, the coal should be cut, in which case boreholes should not be drilled until after the cut or shear is made.

35. Boreholes should be drilled at least 6 inches less than the depth of the cut or shear.

36. Boreholes should be cleaned properly before the charge is placed in the hole.

37. Improperly placed boreholes or holes having insufficient or excessive burden should not be charged.

*38. Electric power should be cut off equipment at or near a face before explosives are taken to such face, during charging, and between charging and firing of shots.

*39. Each primer should be made up at or near the face immediately before loading and in a place removed from tracks, trolley wires, power lines, trailing cables, pipe lines, steel ropes, and conveyor pans.

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*40. Explosives should be suitably stemmed with clay or other incombustible material, preferably to the collar of the hole; in no instance should the stemming be less than 2 feet in length, unless the hole is stemmed to the collar.

41. Only wooden tamping bars should be used.

42. Leg wires of electric detonators should be kept shunted or the ends twisted together until ready to connect to the firing cable.

43. A blasting cable should be:

*a. At least 100 feet in length.

*b. Kept shunted or short-circuited at the battery end until ready to attach to the blasting unit.

c. Staggered as to length at the detonator end, to prevent short-circuiting.

d. Wound up after each shot or adequately supported on timbers or rib.

e. Kept away from track, power wires, pipe lines, and other possible sources of active or stray currents.

44. Worn places on a blasting cable should be properly insulated as soon as observed.

45. Only permissible shot-firing units should be used unless blasting is being done from the surface when all men are out of the mine.

*46. Shots should not be fired from the power or signal circuit while any men are in the mine.

*47. Examination for gas should be made before and after firing a shot or simultaneous shots in a gassy mine.

*48. A shot should not be fired when more than 1 percent of methane is known to be present.

49. Roof and face of working places should be tested before blasting; the roof should be tested and the place examined for fire after blasting.

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*50. The simultaneous firing of several shots with men in the mine should be allowed only if blasting is done with a permissible shot-firing unit, limitation of 1-1/2 pounds of explosive in each hole, and in compliance with other permissibility requirements.

51. Shots should not be fired in rapid succession; delay detonators should not be used.

52. A waiting period of at least 15 minues should elapse before anyone returns to the face when a misfire occurs in instantaneous electric blasting. After such failure the blasting cable should be disconnected from the source of power and the battery ends short-circuited before electrical connections are examined. This also applies to Cardox blasting.

53. If it developes that the circuit outside of a borehole is not the source of failure, the handling of the misfire should be placed under the supervision of a certified foreman or other competent person. This applies to blasting both with explosives and Cardox.

54. Explosives should be removed by firing a separate charge at least 2 feet away from and parallel with the misfired charge, or by carefully washing any stemming from the borehole with water and inserting the new primer. If a separate shot is fired, careful search should be directed toward recovery of the undetonated charge.

55. Cardox misfires due to failure of disk to rupture frequently involve heating the shell, with likelihood of its bursting. With such misfires handled under the supervision of a foreman or other competent person, these shells should be withdrawn from the boreholes only far enough to expose the valve, and the shells should be removed from the boreholes only after the pressure has been released.

56. If a Cardox misfire involves no heating of the shells, the shell should be conspicuously marked upon removal from the hole, and it should be treated as a charged shell while en route to the charging station.

*57. Adobe (mudcap) or other open, unconfined shots should not be fired in any bituminous or lignite mine.

*58. Ample warning should be given before shots are fired; this also applies to Cardox and Airdox blasting.

59. An accurate record should be kept of:

a. The amount of explosives and detonators issued, used, and returned.

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b. The number of misfired shots.

c. The number of blown-out shots.

d. Any holes the shot-firer refuses to charge or fire.

e. The total number of shots fired, misfired, blown out, or burned out.

60. The cut or shear should be reasonably free of machine cuttings and excess water before shooting.

*61. Charged Cardox shells should be transported underground in insulated cars or in insulated boxes placed in ordinary mine cars.

62. Charged Cardox shells should be stored on racks in a crosscut or abandoned room neck at least 10 feet from power lines and haulage tracks.

63. A well-insulated wire should be used for the connection to the insulated or "hot" terminal of a Cardox shell. A new piece of wire should be used for the connection of each blast; the wire may be used a second time for the grounded connection of the shell.

*64. Cardox shells should be wired at the working face only and away from the track, drill truck, or other electric equipment.

65. The ground wire of a Cardox shell should be attached first; the wires should be short-circuited before the "hot" wire is attached and should not be untwisted until it is time to attach the shooting cable.

66. All protruding wires should be removed from all shells, whether charged, discharged, or misfired, before they are removed from the face.

67. Cardox should not be shot off the solid, over heavy rock binders or shale, or in a "tight" shot.

*68. Everyone should be 100 feet or more from a Cardox shot and have, if possible, two or more intervening right angles between him and the shot. "Sprag pipes" or equally effective devices or methods should be used to prevent flying shells.

69. The following recommendations apply to the use of Airdox:

a. Fireproof housing and ventilating requirements for underground Airdox compressor stations should conform to recommendations in these Standards. (Standard 19-26.)

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b. Compressor motor should be protected with compensating starting and overload relays.

c. Compressed air should be conducted from the compressor to within practical working distance of the face by steel tubing tested to a pressure of 20,000 pounds per square inch.

d. As far as practicable, steel air tubing should not be installed in haulage or other regularly traveled entries.

e. All air lines should be grounded.

f. Suitable unions should be installed on all lines of steel tubing at not less than 400-foot intervals.

g. A cut-off valve should be installed in all branch lines close to the main air line and also at the inby end of all steel air lines.

*h. Air lines, either steel or copper, should not be handled or repaired while air pressure is in the line.

i. All copper air lines should be equipped with shut-off valves.

*j. Shooting or release valves should not be less than 45 feet from the face and should be around at least one corner at an angle of 90° with the center line of place in which coal is being broken down.

k. After the breaking down of coal in any one place has been completed, the shell should be disconnected immediately from the air line.

*l. When the release valve is opened to discharge the shell, it should remain open until time to charge the shell in the next borehole.

m. Dust in drill holes should be washed out.

n. When shooting coal, holes should not be drilled on the solid or in the roof. The shell should be pushed to the back of the drill hole, then withdrawn far enough to form an air cushion.

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*c. When the pillar between working places is less than 10 feet in thickness, all men should be removed a safe distance from such adjoining working place before Airdox is released.

*p. Steel or copper air tubing should be suitably insulated where it is across trolley or other electric wires, or where it is under the track.

q. All pressure tanks and lines should be blown out at least once a week, or more often if necessary to prevent any accumulations of oil or moisture.

r. Air tubing should be examined periodically for kinks or other weaknesses and replaced when any defects are found.

*s. The part of the tubing that is affected by frequent coiling and uncoiling should be renewed periodically because of the dangers from kinking and crystallization.

t. The tubing should be properly coiled and uncoiled.

15. Ventilation

01. Main fans should be:

a. Installed on the surface.

*b. In a fireproof housing. If present installations do not meet this recommendation, such installations should be made fire-resistant.

*c. Provided with fireproof air ducts. If present ducts do not meet this recommendation, they should be made fire-resistant.

d. Offset from nearest side of mine opening. If a new fan is installed or the present fan is moved, the offset distance should be at least 25 feet.

e. Provided with ample pressure relief or explosion doors.

NOTE: In lieu of provisions d and e, the fan may be directly in front of or over a mine opening provided the opening is not in direct line with possible forces coming out of the mine in the event of an explosion, and provided further that there

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is another opening having a weak-wall stopping or explosion doors that would be in direct line with the forces coming out of the mine in the event of an explosion, such opening to be not less than 25 nor more than 100 feet from the fan opening.

f. Installed to permit prompt reversal of air flow.

*g. Operated continuously, except when the mine is shut down for an extended period.

h. Provided with pressure-recording gage or water gage.

i. Provided with automatic device to give alarm, unless the fan is constantly attended; and in case of a gassy mine, provision should be made to deenergize, automatically or otherwise, the underground electrical circuits when the fan slows or stops.

*j. Inspected daily.

02. If the main fan of a gassy mine fails or stops for 5 minutes or more, the men should be immediately withdrawn from the mine. After the fan has been started, the mine should be examined thoroughly for gas, and any gas found should be removed before the men reenter the mine. The same procedure should be followed in a section of a gassy mine if it is dependent upon a booster fan.

03. If the main fan of a nongassy mine fails or is stopped for more than 30 minutes, the men should be withdrawn from the mine. Before the men reenter the mine after the fan has been started, the mine should be examined thoroughly for gas, and any gas found should be first removed.

04. If stoppage of a main fan of a gassy mine is more than momentary, mine electric power should be cut off from face sections, and if stoppage is for 5 minutes or more, power should be cut off from the entire mine. A thorough gas examination should be made before power is restored.

*05. The area around fans should be kept free of dry grass, brush, and rubbish for at least 100 feet in all directions.

06. Ventilating fans should be so located that the return air from the mine cannot be drawn into the intake openings.

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07. A stand-by fan, preferably operated by an internal-combustion or steam engine, should be provided at a gassy mine when feasible, to serve if the main fan fails.

08. A booster fan should be used only for ventilating a distant extension of a mine which it is impracticable to ventilate by improvement of airways and if the construction of a new ventilation opening is not feasible. If installed for such reason, the fan motor should be of enclosed type, the surroundings of the fan fireproofed, and the fan so installed and so located with respect to workings as to reduce the possibility of recirculation of air to a minimum. Passage by fan installation should be by means of an air lock, the doors of which should each have at least 30 square feet cross-sectional area and open automatically when the fan stops operating. Under these conditions, sections 15-02-03 and-04 apply.

09. A booster fan should be on a power circuit independent of the mine and should be equipped with an automatic relay to cut off current from that portion of the mine ventilated by the booster fan, if the fan stops.

*10. Auxiliary fans or blowers with tubing should not be used in coal mines, except to ventilate faces of rock tunnels being driven between two coal beds or through faults and wants. However, if so used in rock tunnels, they should be powered with permissible driving units and so placed that recirculation of air is impossible.

11. A mine should be classed as gassy when 0.25 percent or more methane or other combustible gas can be detected by systematic search, or if the mine records establish the fact that methane has been found or ignited.

12. The main-intake and main-return air currents in mines should be in separate shafts, slopes, or drifts.

13. Air in working places or travelways should contain at least 20 percent oxygen and not more than 0.5 percent carbon dioxide, as determined by chemical analysis, and no harmful amount of dust or poisonous gas.

*14. If inflammable gas can be detected in the air of a working place with a flame safety lamp, or if it contains more than 1 percent of inflammable gas as determined by an electric methane detector or by chemical analysis, the ventilation should be improved immediately. If air in the working place contains more than 2 percent inflammable gas (slightly less than 1/2-inch cap on a testing or low flame of a flame safety lamp), the workers should be withdrawn until the ventilation is improved. By "air of a working place" is meant air not nearer than 1 foot from the face. Tests of air for gas should be made at such points as conditions may warrant.

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*15. If the air immediately returning from a split that ventilates any group of active workings contains more than one-half percent of inflammable gas, as determined by chemical analyses in duplicate or by other recognized means of accurate detection, the ventilation should be improved immediately if at all possible. If this air contains more than 1-1/2 percent of inflammable gas, the workers should be withdrawn until ventilation has been improved.

16. The quantity, in cubic feet a minute, of air in any split, circulated through the last open crosscut, should be at least 200 times the number of men and 500 times the number of haulage animals working in the section and as much more as may be required.

*17. The quantity of air reaching the last open crosscut on any pair of working entries or the maximum inby point of a split should be at least 3,000 cubic feet a minute.

*18. Each working place should be ventilated by a perceptible air current sufficient in quantity to dilute and carry away any inflammable or harmful gases that may be present.

19. All entries, rooms, panels, or sections that cannot be kept well ventilated throughout and regularly inspected, or that are not being used for coursing the air, travel, haulage, or the extraction of coal, should be sealed by substantial fireproof stoppings.

20. In every sealed area, one or more stoppings should be fitted with a pipe or valve to allow sampling of the air behind the seals and also to provide a means of determining any existing hydrostatic pressure.

21. Ventilation should not be diverted from idle sections to active sections to provide an adequate quantity of air for different working shifts.

*22. Crosscuts should be made at intervals sufficient to assure adequate ventilation at faces. Ventilation needs are further defined in standards 15-16, 15-17, and 15-18.

23. Stoppings between intake and return of all main haulageways should be as airtight as possible and constructed of substantial incombustible material, except that one temporary stopping of wood or brattice cloth may be erected between the last permanent stopping and the last crosscut. However, in heavy or caving ground, timber laid longitudinally skin to skin may be used.

24. On branch haulageways, stoppings should be as airtight as possible and constructed of incombustible or fire-resistant material with the exception stated in the preceding standard.

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25. All room crosscuts, except the one nearest the face, should be closed with stoppings, preferably of gob wall, dirt, or tight board.

26. Stoppings should be completed promptly as passageways are advanced.

27. Not more than one crosscut should be left open between the faces of entries and the first outby temporary or permanent stopping.

28. A split ventilating system utilizing air crossings should be used instead of doors for conducting ventilation in all main passageways.

29. Where doors are used in connection with coursing the air in any one split or if used in lieu of a split ventilation system they should be:

*a. Installed in pairs to form air locks or, where this is not feasible, tight check curtains, well-maintained, should be hung in connection with single doors. Air locks should be ventilated sufficiently to insure against the accumulation of gas within the enclosed area.

*b. Self-closing.

c. Not provided with latches or other devices to hold them open.

d. Provided with a supply of rock dust on each side for fire emergency use if doors are of wood.

e. Hung so that they swing to the clearance side.

f. Hung so as to open against the ventilating current.

30. Overcasts should be tightly constructed of incombustible material and of ample area to pass the required quantity of air.

31. Trapdoors placed in stoppings should be so hinged or constructed as to be self-closing, tight, and open against the air current. Preferably, their dimensions should be at least 30 by 30 inches.

32. Line brattice should be:

*a. Used to conduct the air from the last open crosscut to working faces when necessary to remove gases, explosives fumes, smoke and dust.

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*b. Constructed with boards at top and bottom or otherwise secured to provide the most adequate movement possible and convey sufficient ventilation to the face.

c. Be of mildew- and fire-resising material.

33. The space between the rib and the line brattice should be large enough (approximately 3 feet in width) to permit free flow of air, and this space should be kept clean; posts should be on the wide side of the brattice.

34. Rooms or chutes should not be worked off an entry heading in advance of the last crosscut, even if line brattices are utilized. This does not apply to the driving of such places to make a connection at the first crosscut or similar passageway used as a main airway in connection with an entry. It does apply to extending such places beyond the airway before the main intake and return passageways are connected.

*35. Working places should not be ventilated by an air current that has passed through abandoned workings or pillar lines that cannot be, or are not, regularly inspected. (It is hazardous to work places ventilated by air currents from partly caved areas.)

36. Airways should be kept clear to permit free passage of air; this includes nonhaulage air courses as well as those utilized for haulage or man-travel.

37. Changes in ventilation which may affect the safety of the men should be made when the mine is idle and with no men in the mine other than those engaged in changing the ventilation.

*38. At least two permissible flame safety lamps should be kept in proper working condition at every coal mine, and at least two persons should be kept well-informed as to the safe maintenance and use of flame safety lamps.

39. All coal mines classed as nongassy should be carefully inspected for methane at least once a month.

*40. Only permissible methane detectors should be used for making inspections for explosive gas. (Permissible flame safety lamps are considered a type of permissible methane detector.)

41. All men required to use methane detectors should be thoroughly instructed in their use and limitations.

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42. Firebosses and others who are required to test for gas should wear corrective-lens glasses if necessary for good vision.

43. Enough firebosses should be employed in gassy mines; they should:

*a. Begin examination of the mine not more than 3 hours before each shift enters the mine.

*b. Examine every working place, all places adjacent to live workings, every roadway and travelway, every unfenced road to abandoned workings, and all accessible falls in the mine for explosive gas and other hazards.

*c. Leave at or near the face of each place examined their initials and the date.

*d. Place a danger sign across the entrance to every place where a dangerous condition is found. The danger sign should be removed only by a certified official after the danger has been removed.

*e. Report to a proper official on the surface or at designated underground stations, any dangers found before the men enter the mine or pass such designated stations.

*f. Record in ink the result of their inspection, in a book kept on the surface for that purpose. Similar records also should be kept at designated underground stations.

44. Pillar workings should be examined for explosive gas and other dangers before a cave is made, and if gas is found in amounts that can be detected with a permissible flame safety lamp, the cave should not be made until gas is removed or, if removal of gas is not permissible, other precautions should be taken to safeguard all employees.

*45. The mine foreman or his designated assistant on each shift should read and countersign the fireboss' reports of examination before that shift before the men enter the mine or pass designated underground stations. The mine foreman should read and countersign the assistant foreman's and fireboss' reports daily.

46. Haulage and hoisting openings and main and intermediate haulageways should be on intake air. It is recognized, particularly in view of war conditions, that changes in ventilation to comply with this standard are of

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such magnitude that it would be impracticable to carry them out at present. However, such changes should be made as soon as feasible.

47. Air measurements should be made by the mine foreman, his assistants, or other certified official at least once each week at or near the mouth of the main intake and return of the mine and also in or immediately adjacent to the last crosscut on each air split. Tests should be made with a permissible flame safety lamp or other methane indicator in such splits and in the main return. A record of these measurements and tests should be kept in a book furnished for this purpose.

48. Accumulations of gas should be removed under the direct supervision of a foreman or other competent official, and no men should be permitted to work, or electric equipment be operated, on the return of the split while gas is being removed.

16. Control of Coal Dust and Rock Dusting

*01. Coal dust should not be permitted to accumulate on roadways, along conveyor lines, and on gob, rib, roof, or timbers.

*02. Machine cuttings from coal beds, unless the dust therein contains more than 65 percent incombustible, should be loaded and hauled out of the mine if at all practicable. If removal from mine is not practicable, cuttings should be placed back from the face and covered with a layer of one-half inch or more of rock dust.

03. Mine cars should be maintained as dusttight as possible.

04. Coal should be so loaded that it will not spill off during transportation.

05. Water or wetting solutions should be used to allay coal dust:

*a. On the cutter bar or cutting chain of mining machines, or sprayed on the dust as it emerges from the kerf.

b. Before and after blasting.

c. On the coal pile before and during loading.

*d. At the unloading head of conveyors or scrapers.

e. On loaded and empty trips.

f. In the face region and back to the last application of rock dust.

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*g. At underground dumps.

*06. All bituminous-coal mines (lignite mines excepted) should be kept thoroughly rock-dusted, in all open, unsealed places to within at least 40 feet of the face. If the top, floor, and sides of the mine (or any part thereof) are wet, rock dusting is not required in such mine or part thereof; however, if there is any indication that the mine, or any part thereof, is becoming dry, the mine or portion of the mine so affected should be rock-dusted.

*07. Where rock dust is applied, it should be distributed upon the top, floor, and sides of all open, unsealed places and maintained in such quantity that the incombustible content will not be less than 65 percent.

08. When methane is present in the ventilating current, the 65 percent minimum percentage of incombustible should be increased 1 percent for each 0.1 percent methane.

09. Sampling should be done with sufficient frequency to determine whether additional rock dust is required.

10. A record should be kept showing the location of the places of sampling, the results of the tests made, and the amount of rock dust applied monthly as well as annually.

17. Surface Haulage

01. Track and roadbed should be maintained in good condition.

*02. There should be a clearance of 30 inches or more on at least one side of tracks, but if it is not practicable to obtain such clearance at some places, these places should be marked with signs warning of restricted clearance.

03. Frogs and guard and lead rails should be blocked if there is danger of persons catching their feet in them.

04. Track switches should be proved, complete with throws and bridle bars.

05. Switch throws should be so installed as to provide adequate clearance for switchmen.

06. The rod extending from the bridle bar to the throw should be covered or the stumbling hazard otherwise minimized.

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*07. Outside planes or inclines should have:

a. A positive stopblock at the top.

b. A derail near the top.

c. A derail near the bottom.

*08. Man-trips or man-cars on mechanical or gravity planes or inclines should be provided with a safety rope or chain secured to the main rope above the regular hitching and extended around or through all cars. In addition, it is desirable that they should be provided with positive mechanical devices to stop the trip if the main rope fails.

09. Where surface operations require that many persons pass over the haulageway, a warning signal should be installed or an overhead walkway or underpass provided.

10. All track crossings should be provided with warning signs.

11. Crossings on the surface should be guarded while cars are being moved.

12. Derail devices should be installed where necessary on all side-tracks on the surface near junctions with main lines.

13. In handling railroad cars, brakemen should:

a. Use a suitable brake stick, preferably made of metal.

b. Use a safety belt.

c. Wear a safety hat.

d. Use a railroad-type pinch bar for shifting cars.

e. Wear snug-fitting clothing.

14. When men are transported in cars on outside planes or inclines:

a. They should be provided with level seats and handholds.

*b. Tools or other material should not be carried in the same cars.

*c. Explosives or detonators should not be transported on man-cars or man-trips.

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18. Underground Haulage

01. Haulage roads should be kept free of coal spillage and debris.

02. Rails should be heavy enough to carry safely the heaviest rolling stock and should be firmly attached to ties of adequate size and spacing.

03. On all haulage roads, rail joints should be connected with plates or welded and rails be well-supported by ties.

04. The track should be properly alined and free from high or low joints, broken rails, defective switches, defective frogs, and improperly alined frogs.

05. Roadbed should be kept well drained and surfaced.

06. Frogs and guard and lead rails should be blocked if there is danger of persons catching their feet in them.

07. Track switches should be provided, complete with throws and bridle bars.

08. The rod extending from the bridle bar to the throw should be covered or the stumbling hazard otherwise minimized.

09. Switch stands should be placed on the clearance side, preferably in shelter holes.

10. Switches on main and cross or face entries should be illuminated with electric lights. However, these lights should not be installed within 150 feet of end of pillars, workings, or any open, partly caved, poorly ventilated places.

*11. Internal-combustion engines should not be used undgerground.

*12. Steam locomotives should not be used underground.

13. Where two or more locomotives or other self-propelled track-mounted equipment are operated independently on the same track, a block or telephone signal system should be used to control their movement.

*14. Self-propelled track-mounted equipment, including locomotives, cutting machines, and loaders, should be handled carefully and kept under control at all times. Such equipment should be provided with efficient headlights and warning devices. When this equipment is moved into or out of a

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working place, it should be stopped at any intersection or curve and be preceded by a helper or flagman.

15. Pushing of cars should be eliminated insofar as possible; trips should not be pushed on main haulageways except at partings or in emergency.

*16. Sprags, chains, or car blocks should be used on all standing cars, regardless of grade. If cars have brakes, they also should be set. The use of chips or small pieces of coal or rock or similar makeshifts should not be considered adequate blocking.

17. An effective drag, or equivalent positive mechanical device, should be used on trips, on main and intermediate haulage, ascending grades exceeding 3 percent.

18. On all inside slopes and planes having a knuckle, there should be a positive-action safety block at or above the knuckle.

19. A positive stopblock or derail should be placed below the switch of the first active working place on entries going to the rise.

20. On entries going to the dip, a positive stopblock or derail should be placed just above the switch to the first active working place, and a stopblock should be placed just below the switch to the last active working place.

21. When coal is not being loaded in a room or entry face and, nevertheless, men are working therein, a positive stopblock or derail should be placed across the room or entry track or room switch kept closed to prevent cars from being inadvertently pushed into place.

22. Slides or skids should be used on descending grades where the locomotive is not adequate to control the trip.

*23. A permissible trip light should be used on the rear of all trips and on the front of cars being pushed. Reflector buttons should not be substituted for trip lights.

24. Animals working underground should be provided with permissible electric lights.

*25. Where practicable, there should be a continuous clearance on one side, from the mine portals to all working faces, of at least 30 inches from the nearest obstruction to the farthest projection of moving equipment.

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23. On the other or trolley-wire side there should be a clearance of at least 12 inches from the nearest obstruction to the farthest projection of moving equipment.

*27. Clearance should not be obstructed by loose rock or coal, supplies, or other material.

28. At sidetracks there should be a clearance of at least 30 inches between the farthest projection of equipment on any two tracks.

29. Shelter holes should be:

*a. Provided along all haulageways if used as traveling ways.

b. Suitably marked.

c. On the clearance side.

d. Not more than 60 feet apart.

e. Not more than 4 feet wide and not less than 5 feet deep, and 6 feet in height or as high as the traveling space if it is less than 6 feet. Room necks and crosscuts complying with the above standards should be considered as shelter holes, even though wider than 4 feet.

f. Provided at all switch stands.

g. Provided on both sides of all doors.

h. Kept clean and free of obstruction.

*30. Only authorized persons should operate locomotives.

*31. Riding on locomotives should be prohibited except to those operating the trip and persons authorized by management.

*32. Riding on top of loaded cars, between cars, or on bumpers in front of cars should be prohibited.

33. Motormen or brakemen should not get on or off cars or trips in motion.

*34. When the motormen leaves a locomotive, even temporarily, the controller should be set at neutral, the brake set tightly, and the trolley connection removed from the wire.

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*35. Back-poling should be allowed only at places where the trolley pole cannot be reversed and at very slow speed of the locomotive.

*36. "Nipping" should not be permitted.

*37. Flying switches should be prohibited.

38. At least two cars should be placed between the locomotive and cars or trucks carrying rails or long timbers.

39. An interval of at least 500 feet should be maintained between "light" locomotives traveling in the same direction; the locomotives should be held to a low speed.

*40. Cars should not be coupled by hand while they are in motion.

*41. Cars should not be coupled by hand from the inside of curves.

*42. Locomotives approaching and passing through doors should be operated at reduced speed for at least 100 feet on each side of the door.

*43. Short pieces of rail, ties, or props should not be used to raise or slue derailed cars and locomotives.

*44. Locomotives should be equipped with suitable rerailers, jacks, and other necessary tools for rerailing cars or locomotives.

45. If necessary, toeplates should be installed in the cabs of locomotives and safety chains provided on the locomotive motors.

46. Insulating mats should be provided for the floor and seat of the locomotive cab.

47. Cars and trips should not be left standing in a place where they will endanger other trips or persons.

*48. Motormen, brakemen, drivers, and others should not leave ventilation doors or curtains open.

49. Cars and trips should not be left standing where they materially obstruct the ventilating current.

*50. An official or other authorized person should be in charge of and accompany each man-trip.

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51. Man-trips should be operated at a safe speed.

*52. Man-trips should not be operated behind loaded trips on ascending grades, nor in front of loaded trips on descending grades.

53. Enough cars should be provided on man-trips to permit all men to ride inside and prevent crowding.

54. Men on man-trips should not ride in the car next to a trolley locomotive unless such car is specially designed to afford front-end and overhead protection.

55. When riding in a car on a trolley haulage road, men should ride on the side of the car opposite the trolley wire unless suitably covered man-cars are used.

*56. Persons other than the brakeman should not be permitted to ride on the rear bumper of a man-trip, and no person should be allowed to ride between cars.

57. The man-trip should come to a full stop before men load and unload.

58. A suitable place with seats should be provided at junction points where men may congregate while waiting for man-trip; it should be where lives of persons waiting would not be jeopardized by a runaway car or trip or the wrecking of car or trip.

*59. Only tools and supplies that can be carried entirely inside a separate car should be hauled on man-trips.

60. If there is any hazard of men contacting the trolley wire, at man-trip loading and unloading stations, the power should be cut off while men are loading or unloading; also, the wire should be adequately guarded at these stations.

61. Barrier gates that close automatically, or overpasses or underpasses, should be provided at places where manways cross haulageways.

62. Haulage equipment should be maintained in safe condition.

63. Underground hoists should be equipped with brakes adequate for the required service.

64. If underground hoists are used for handling men:

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*a. An accurate indicator of the trip position should be so placed as to be in constant view of the hoistman.

*b. A second hoistman should be in attendance at all times while a man-trip is being hoisted or lowered unless the hoist is equipped with automatic overwind and overspeed and automatic stop controls.

c. No rope should be used which shows more than six broken wires in any single pitch length or lay, or when the wires in the crown of a strand are worn to less than 65 percent of their original diameter, or when inspection indicates a dangerous amount of corrosion or distortion.

65. Ropes should be of adequate size and strength for the required service.

*66. Ropes should be replaced as soon as there is evidence of undue weakness or other conditions which indicate that the rope may fail.

*67. Man-trips or man-cars on mechanical or gravity slopes or inclines should be provided with safety rope connected to the main rope at a point above the regular hitching and extending around or through all cars. In addition, it is desirable that they be provided with mechanical devices to stop the car or trip in event of failure of the main rope.

68. Ropes, links, chains, and rope sockets should be examined carefully at least every 24 hours by a competent person.

69. Drum guides or flanges should be high enough to keep rope from slipping off ends of drum.

70. Rope end should be secured to drum or drum shaft.

19. Electricity

*01. Overhead high-potential power lines should be placed at least 15 feet above the ground and 20 feet above driveways and should be supported and guarded adequately to prevent contact with other circuits.

02. High-potential power lines should be protected adequately by circuit breakers.

03. The wires of all circuits should be of ample capacity for the current carried.

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04. Surface transformers within 15 feet of the ground should be enclosed in a transformer house or by a substantial fence suitably located and at least 6 feet high.

05. The gate or door to the transformer enclosure should be kept locked at all times unless authorized persons are present.

06. DANGER--HIGH VOLTAGE signs should be placed on all transformer enclosures, high-potential switchboards, and other high-potential installations.

07. Casings of all transformers should be grounded unless protected by isolation (freedom from contact hazard by position or fencing).

08. Switchboards should:

*a. Have ample working space around and back of them, free of rubbish and stored material.

b. Have entrance at each end to permit authorized persons to inspect, adjust, or repair apparatus back of switchboard.

c. Be adequately lighted.

d. Have control readily accessible for emergency shutdown.

e. Have cut-out switch on incoming circuit at or near entrance to rear.

f. Have entrance to rear guarded.

*09. Rheostats and electric heaters should be placed a safe distance from combustible material and effectively protected against contact and fire hazards.

10. Switches and circuit breakers controlling the operation of stationary motors and electric lighting should be so placed that they are readily accessible and can be reached without danger of contact with moving or charged parts.

*11. Electric wiring in all surface buildings should be so installed as to present minimum fire or contact hazards.

12. Guy wires from poles supporting high-potential transmission lines should be grounded. If insulators are used, they should be installed near the poles.

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13. Telephone circuits should be protected on the surface by lightning arresters (protector blocks).

14. Electrically driven equipment that is operated inby the first open crosscut between entries or rooms, or in air that has ventilated one or more working places in mines classed as gassy, should be permissible. It is recognized that under war conditions it may be difficult, if not impossible, to obtain permissible equipment and that nonpermissible equipment is now and will continue to be used in gassy mines. Where used, all possible precautions should be taken.

15. If nonpermissible electric equipment is used in face regions (inby first open crosscut or air that has ventilated one or more working places) of gassy mines, it should be operated only under the following conditions:

*a. Each working place should be carefully examined for methane by a certified official or other competent person immediately before the equipment is taken into or operated in a working place.

*b. The general air of the place should not contain more than one-half of 1 percent of methane as determined by analysis or other recognized means of detecting methane. (By "air of place" is meant air not nearer than 1 foot from face. Any indication of methane on a flame safety lamp should be regarded as more than one-half of 1 percent of methane.)

*c. If more than 1 percent methane can be found in holes in the roof of any working place by analysis or by methane detector (flame safety lamp or electric detector) the equipment should not be taken into or operated in the working place until the pocket of gas has been removed by additional ventilation.

*d. When electrical equipment is used in face regions, tests for methane should be made at least every 30 minutes by a certified official or other competent person.

e. Replacement of equipment, so far as feasible, should be of permissible type.

*16. Electrically driven permissible equipment should not be taken into or operated in any place if methane can be found, by analysis or other recognized means of detecting methane, amounting to more than 1 percent in the general air of the place.

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17. Electrically driven permissible equipment operating in face regions in a gassy mine should be stopped at least every 30 minutes and the place carefully examined for methane by a certified official or other competent person.

*18. Permissible equipment should be maintained in a good state of repair and in permissible condition, as determined by a rigid examination each week by a person well-informed in the safe use of electricity underground and in the maintenance of equipment; a record should be kept of the defects found and how they were remedied. Repairs should not be made or the electrical parts opened at or near the face, while the power is on the machine or cable.

19. All electric appliances, machines, and conductors should be large enough for the required work.

20. All metallic coverings and armor of cables and conduit should be grounded and should be electrically continuous to afford a conductor path for the ground circuit.

21. All metallic frames, casings, and coverings of motors, generators, switchboards, and other electric equipment that can become "alive" through failure of insulation or by contact with energized parts should be grounded.

Note to inspectors: All electrical equipment having a rated capacity of 15 horsepower or 10 kilowatts or more should be provided with a frame-ground equivalent to No. 0 copper wire. Electrical equipment having a rated capacity less than 15 horsepower or 10 kilowatts should be provided with a frame-ground equivalent to No. 6 copper wire.

22. Where a grounded return system is used, all underground metallic pipe lines 1,000 feet or more in length and all metallic pipe lines leading outside the mine should be bonded to the return at the ends and also at intervals not exceeding 500 feet.

23. The frames of drills and other electric tools intended to be held in the hands while being operated should be grounded.

24. A potential higher than 250 volts should not be used for operating drills or other electric tools intended to be held in the hands. Electric drills or other electrically operated rotating tools, intended to be held in the hands, and, where feasible, post drills, should have the electric switch so constructed as to break the circuit when the hands release the switch.

*25. Underground electric stations for permanent installations of pumps, compressors, motor-generator and other conversion equipment, battery-

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charging stations, and transformers should be located in well-ventilated, fireproof rooms.

23. Permanent underground stations having transformers filled with inflammable oil should be provided with doors that close automatically in case of fire; when practicable, these stations should be on separate air splits leading to the return; such stations should be provided with door sills, or their equivalent, that will confine the oil in event of leakage or explosion.

*27. Portable pumps and other portable electrically driven equipment should be so located and installed as to constitute the minimum possible fire or man-contact hazard. They should be used only in well-ventilated places.

*28. Portable transformer stations should be in fireproof housings which are either fully enclosed or fitted with doors that close automatically in case of fire. They should be located only in well-ventilated places.

*29. Temporary battery-charging stations should be located on separate air splits, the return from which does not pass through any active workings. Such stations should be installed in fireproof rooms.

*30. Dry wooden platforms, rubber mats, or other electrically nonconducting material should be kept in place near all switchboards and machinery where contact hazards exist.

31. Wires or other substitutes that do not provide adequate protection should not be used in place of proper fuses.

32. Fire extinguishers approved for electrical fires should be available at all electric installations. If such extinguishers cannot be obtained, rock dust should be available.

33. Clean, dry sand or rock dust and, if available, fire extinguishers, suitable from both a toxic and shock standpoint, should be provided and placed outside of underground electric stations so as to be out of the smoke in case of fire in the station.

*34. Dry wooden platforms, rubber mats, or other electrically nonconducting material should be kept in place in front of and around all switchboards, starting switches, and stationary electrical installations underground.

35. Trolley and bare power wires should be:

a. Securely supported on insulated hangers not more than 30 feet apart.

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b. Kept taut and not permitted to contact the roof, rib, cross bars, or doorframes.

c. Properly alined and placed at least 6 inches outside the rail.

d. Installed on the opposite side from the clearance side and shelter holes.

*e. Sectionalized by proper electric switches at intervals not to exceed 1,500 feet; electric switches should also be installed in all branch lines near their beginning.

f. Provided with sectionalizing switches at points where loaded mine cars are stored on idle days.

*g. Adequately guarded where men are required to pass under the wire, unless the wire is 6-1/2 feet or more above the top of the rail.

h. Adequately guarded and sectionalized at man-trip stations.

i. Adequately guarded throughout unless the wire is 6-1/2 feet or more above the top of the rail.

j. Cut off and fastened with an insulated turnbuckle at inby end.

k. Securely anchored and properly insulated at the ends.

36. Power should be disconnected when repair work is being done on electric equipment, and accessories such as trailing cable, feed wire, trolley wire, switches, junction boxes, and the like.

37. Power and trolley wires should be properly guarded on both sides of all doors.

38. Power wires, other than trolley wires, should be properly insulated when passing through doors or stoppings.

*39. Power wires, whether bare or insulated, should be supported on or by well-designed and installed insulators.

*40. The ends of trolley or feed wires should not extend beyond the last open crosscut and should be kept at least 150 feet from the end of pillars, workings, or any open, partly caved, poorly ventilated places.

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41. If feasible, power should be cut off from idle sections of a mine and from the entire mine on idle days. This statement is not, however, intended to bar the use of lines, properly protected by fuses, for the operation of such units as pumps if all passageways and adjoining areas through which live circuits pass (including surroundings of units) are examined with a flame safety lamp and found free of gas.

42. Underground electric equipment should be provided with switches of safe design, construction, and installation.

43. Officials, haulage crews, electricians, and others connected with electrical maintenance should be familiar with the location of cut-out switches.

44. Cut-out switches should be marked so that they may be found readily in case of emergency.

45. Circuit breakers should be provided to protect all power circuits. If they are automatic, they should be set so that the circuits cannot be overloaded; if they are hand-set, the handles should not be tied in place.

*46. Electric equipment should be protected against excessive overload by fuses or equivalent protective devices of the correct type and capacity.

*47. Wiring in underground structures should be insulated and installed properly.

*48. Telephone service should be provided from the surface to the working sections of a mine 2,500 or more feet from the surface.

49. Telephone wires should be installed on the opposite side from power or trolley wires where at all practicable.

50. Telephone wires crossing power or trolley wires should be adequately insulated.

51. Telephones should be grounded or protected by insulating transformers (repeating coils).

52. If track is used for the return circuit, both rails should be well bonded at every joint and cross-bonded at least every 200 feet.

53. Signal wires should not carry in excess of 24 volts. (This does not apply to block-signal systems.)

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54. Signal wires should be supported on insulators.

55. In gassy mines, permissible junction or distribution boxes should be used, where feasible, in making power connections at working faces.

*56. Cables for portable or semiportable underground electric equipment should be provided with suitable taps equipped with fuses, unless properly connected to permissible junction or distribution boxes.

57. Temporary cable splices should be made in a workmanlike manner, mechanically strong, and well-insulated. Preferably, when a cable is defective, a stand-by cable should be used and the defective cable sent to the shop for permanent splicing and, if practicable, vulcanizing.

Note to inspectors:

Temporary cable splices may be made as follows:

1. The conductors should be joined together with proper splicing rings or other suitable device that will insure a good electrical and mechanical connection. In concentric cables, the outside wires may be individually joined by splicing rings, twisting, or soldering.

2. The spliced conductors should be reinsulated with rubber tape, preferably self-vulcanizing, so as to have the same or greater dielectric strength as the original insulation, the rubber on each conductor should be covered with P & B tape or its equivalent, and both conductors should be covered with rubber tape and finished with P & B tape or its equivalent.

Permanent cable splices may be made as follows:

1. The conductors should be joined together with proper splicing rings or other suitable device.

2. Splices should be properly vulcanized.

58. Permanent cable splices should be made by competent persons in surface or underground repair shops.

59. To prevent excessive heating, the trailing cables of equipment used in conveyor mining should be suspended in long loops, rather than tightly coiled.

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60. Instructions in artificial respiration should be posted at every electric station and at or near the entrance to the mine.

61. All employees working with or around electrical equipment should know how to give artificial respiration.

62. Electric lights on the slope or shaft bottom should be on a separate circuit from the trolley circuit.

63. Lighting circuits should be provided with adequate fuses.

64. Lighting wires should be supported by suitable insulators, connected to the trolley or power line with clamps.

65. The ground connection for lighting wires taken off the trolley circuit should be made to the track circuit.

66. Electric lights should be so placed that they cannot come in contact with combustible material.

67. Electric lights should not be used at or near any working face unless of permissible type.

68. Lamp sockets with exposed metal parts should not be used underground.

20. Machinery and Safety Appliances in Connection Therewith (Surface and Underground)

01. Machinery and belting exposed to possible personal contact should be guarded adequately, as indicated below:

a. Gears, sprockets, friction devices, and couplings with protruding bolts or nuts should be completely guarded.

b. Shafting and projecting shaft ends within 6 feet of floor or platform level should be completely guarded.

c. Vertical or inclined belt, chain, or rope drives should be suitably guarded to a height of at least 7 feet from the floor.

d. Horizontal belt, chain, or rope drives within 7 feet of floor or platform should be guarded.

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e. Fly wheels should be guarded. Where fly wheels extend more than 6 feet above the floor, they should be guarded to a height of at least 6 feet.

f. Circular and band saws and planers should be adequately guarded.

g. Locomotive pits should be properly guarded, and guard kept in place when the pit is not in use.

h. When guards are removed for oiling or repairs they should be promptly replaced.

02. Hand tools should be kept in good condition.

03. If axes are used underground, the combined length of the ax and handle should not exceed 18 inches.

*04. Men should be required to wear safety goggles when using grinding tools and when doing other work where particles are likely to fly. Preferably, all mine employees should wear goggles at all times in and around mines. Where corrective-lens goggles are needed, they should be used.

*05. Welders and helpers should be provided with proper shields to protect their eyes.

*06. Stationary welding locations should be well ventilated and shielded.

07. Mechanically operated grinding wheels should be equipped with:

a. Safety washers.

b. Substantial retaining hoods, the throat openings of which do not expose more than a 90° segment of any wheel. Preferably, not more than a 60° segment should be exposed.

c. If grinding operations are frequent or constant, a dust-collecting system should be installed to remove liberated dust, or a permissible respirator should be worn by the operator.

08. Surface machines should be adequately illuminated.

09. Adequate clearance should be provided at machine installations, and passageways should be kept free of stumbling hazards.

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10. Machinery should not be repaired while in motion or oiled while in motion, unless such oiling can be done without danger to the oiler.

11. A guard or safety device removed from any machine should be replaced before the machine is put in operation.

12. Adequate tools should be available in working places, and these should be maintained in good condition.

13. Mining machines should not be loaded on their trucks or moved unless they are equipped with adequate locking devices on the cutter chains, and the exposed bits at the cutter bar guarded or removed.

14. To prevent injury from side slip of caterpillars from rail, the operator of caterpillar machine should ride on the step provided for that purpose when moving from place to place.

15. Machineman, drillers, and loading-machine operators should not operate their equipment when any persons are in such proximity as to be endangered.

*16. Rock drilling with percussion drills should be done wet. Men drilling rock with auger-type drills should wear either approved-type respirators or use water, if dust is produced.

21. Fire Protection Underground

*01. Underground storage places for lubricating oil and grease should be of fireproof construction.

*02. Lubricating oil and grease kept in face regions or other working locations should be in portable, closed, metal containers.

*03. Inside structures (substations, shanties, stables, pump rooms, etc.) should be of fireproof construction, including doors. Where the fireproofing material is in contact with timber of coal, it should not be of metal.

*04. Hay or straw should be stored in a fireproof structure apart from the stable.

05. Welding and cutting (with electricity or flame) in gassy mines in face regions and on returns should be done under the immediate supervision of a certified official. No welding or cutting should be done if methane is present in quantity of more than 0.50 percent. In all welding and cutting operations, special precautions should be taken against starting a fire.

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22. Miscellaneous Hazards

*01. An accurate map of the mine, brought up to date at least every 3 months, should be posted in a convenient place accessible to employees.

02. The map posted at the mine should show, in addition to the mine workings:

a. Direction of air currents passing through main headings, cross headings, and working places, by arrows in colors.

b. Location of doors, overcasts, and regulators.

c. Location of telephones, power and trolley lines, and permanent electric equipment.

*03. When a limit of 200 feet is reached from abandoned workings that cannot be inspected or workings filled with water not in excess of a 150-foot head, or gas, boreholes should be kept at least 20 feet in advance of the face, and similarly, 45° angle holes at least 25 feet deep and not more than 8 feet apart should be made in each rib. If the head of water exceeds 150 feet, the depth of the boreholes should be increased 1 foot in length for each additional 10-foot head of water.

04. Main slope and drift openings should be separated by at least 50 feet of natural ground. (Inspector: This applies only to future openings.)

05. In regard to mine openings:

*a. Every underground mine should have at least two separate outlets to the surface.

*b. Each bed of coal and each level or entry therein should have at least two travelable openings in connection with (directly or indirectly) both main outlets to the surface.

*c. It is not necessary that the two main outlets belong to the same mine if persons can travel safely to, and out of, either outlet from either mine.

*d. When a new mine is being opened or when a new entry or level is being worked for the purpose of making a connection between the two main outlets, not more than 20 persons should be allowed at any one time in such mine, entry or level.

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*e. When only one main outlet is available, due to final mining of pillars, not more than 20 persons should be allowed in such mine at any one time.

*06. Designated escapeways should be readily accessible from every section of the mine and should be kept in a safe condition, reasonably free from steam, dangerous gases, standing water, ice, and other obstructions.

07. Designated escapeways should be high and wide enough to allow men to travel safely.

08. Direction signs should be posted conspicuously to indicate manways and designated escapeways.

*09. If the designated escapeways are shafts:

*a. They should be equipped with hoist and cage, or with a travelable stairway.

*b. If equipped with stairway, it should be of substantial construction, set at an angle not greater than 45° with the horizontal, and equipped on at least one side with suitable handrail; landing platforms should be at least 2 feet wide and 4 feet long, at easy and convenient distances, and should be railed properly.

*c. If the shafts are not more than 30 feet deep, a ladder may be used in lieu of a stairway. Such ladders should be fastened securely. The rungs should be fastened securely, spaced equally, and not more than 15 inches apart.

*d. Ladders or stairways should be kept in good repair, with landings free of debris.

*10. If a designated escapeway is a slope of more than 30°, it should be equipped with stairway or ladder and have landings at intervals not to exceed 50 feet.

11. If a designated escapeway is a drift or a slope inclined less than 45° from the horizontal, incombustible walls (or lining) should extend at least 200 feet from the entrance. If such designated escapeways do not meet these requirements, adequate fire protection should be provided.

12. If only way of escape has incombustible walls or lining, it should be the normal intake airway.

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13. All surface openings to underground workings that are not necessary for operation of the mine should be kept securely closed to prevent unauthorized persons entering, but they should be locked in such a way as not to prevent the escape of employees in an emergency.

14. All openings necessary for operation of a mine or for escape should be guarded against unauthorized entrance of persons, but so as not to prevent the escape of employees in an emergency.

*15. A check-in-and-out system should be adopted that will provide positive identification, upon the person, of every individual underground. An accurate record of the men in the mine should be kept in a place that will not be affected in the event of an explosion.

16. Oil and gas wells penetrating strata below beds of coal should be protected by a pillar of coal extending at least 50 feet from the well in every direction.

17. If oil or gas wells penetrate open workings:

a. A surrounding wall or pier of cement, masonry, or concrete should be constructed of a diameter exceeding the height of excavation, or at least 48 inches.

b. The casing should be surrounded by an outer steel casing extending 20 to 30 feet below the coal bed, and open to the outside atmosphere for relief of any gas liberated.

18. Every oil or gas well penetrating a workable coal bed should be properly plugged from the bottom of the well to the surface when abandoned, and a record made thereof. If necessary, a 2-inch vent pipe should extend from at least 30 feet below the lowest coal bed to not less than 10 feet above the surface.

19. All oil and gas wells should be indicated accurately on the mine map.

20. A 50-foot barrier pillar, or larger if deemed necessary, should be left when workings adjoin old workings suspected of containing bodies of dangerous gas. If the danger is from water, the barrier pillar should be of such width as is determined by qualified engineers and approved by the proper State agency.

21. A pillar of suitable thickness should be left below each level to be maintained in coal beds pitching more than 30°.

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22. A refuge hole at least 10 feet deep, 4 feet wide, and 6 feet high should be provided at the bottom landing of a slope.

23. Underground stables should be ventilated by separate splits of air, with vents to the return aircourses.

*24. Smoking should not be permitted in any mine.

25. Search of employees for smoking material, matches, and other lighting devices should be made frequently and in a manner to assure that such articles are not being carreid into the mine.

*26. Only permissible portable electric lamps, preferably cap lamps, should be carried by all persons for illumination in a mine.

*27. Protective hats should be worn by all employees, officials, and others while on duty in mines and also in work on the surface where there is danger from falling objects.

*28. Protective footwear should be worn by employees, officials, and others while on duty in and around mines.

29. Gloves should be worn when material is handled that may injure the hands.

30. Haulagemen and others who work around machinery should wear snug-fitting clothing and have trouser legs held with boots or puttees, tucked inside socks, or otherwise fastened. When electric cap lamps are worn by such employees, the lamp cables should be concealed under their clothing.

GENERAL SAFETY CONDITIONS

23. Supervision

NOTE: Wherever certified officials, such as certified firebosses, are mentioned in these standards, officials certified by the State are meant. If the State requires no certification for such officials, they should be men well-versed in the duties of their positions, through mining experience and training, and such positions should be designated in wirting by the management. In the interest of safety, the Bureau of Mines believes that State certification of mine officials is desirable.

01. The foreman or other person in charge of underground operations and all assistant foremen should have a certificate of competency from the State if the State issues such certificates.

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02. A record of foremen's certificates should be kept at the mine.

03. Firebosses, shot firers, drillers, and cutting-machine and mechanical-loader operators should have a certificate of competency from the State if the State issues such certificates.

*04. Idle or abandoned sections of a mine should be inspected for gas and other dangerous conditions by a foreman or fireboss immediately before other employees are permitted to enter such sections.

*05. Aircourses and accessible pillar falls should be traveled at least once each week by a certified mine official, who should leave his initials and the date; if any part or parts of the aircourse are in such condition that it cannot be traveled, the defective condition or conditions should be remedied promptly.

*06. All entrances to dangerous places should be fenced off and suitable danger signs provided at safe distances from the existing hazard.

*07. A statement of all dangerous conditions observed should be recorded in ink daily in a book, signed and dated by the mine foreman and countersigned by the superintendent.

*08. Each working place should be inspected for safety by a certified official at least twice each working shift and at such more frequent periods as may be necessary and practicable.

24. Safety Organization

01. A safety engineer or director should be employed for mines employing 100 persons or more.

02. A safety organization of officials and employees should be established if practicable.

03. Joint safety meetings of men and officials should be held at least monthly.

04. A bulletin board should be provided and posted with suitable bulletins if available.

*05. Accidents involving injury to persons and other serious accidents should be investigated and a record kept of such investigations.

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06. Responsibility for accidents should be placed, if it is feasible to ascertain such responsibility.

07. A safety committee, including workmen and officials, should make periodic inspections of the mine and submit recommendations for correcting hazards observed.

08. A record should be kept of all lost-time accidents; these should be summarized monthly as well as annually and studied with a view to making needed corrections in practice.

25. Safety Rules and Standards

01. Special company rules regarding mine safety should be adopted and published; they should be approved by the State agency governing mining, where such approval can be obtained.

02. New employees should be fully instructed regarding the company safety rules and the particular hazards incident to their work; this applies to both experienced and inexperienced personnel.

03. Where practicable, new employees should be furnished with a copy of the mine safety rules.

04. Employees should become conversant with the State mining law with the aid of such instruction and assistance as may be obtained from the company or available educational agency. Compliance with the mining law should be required of all employees.

26. First Aid and Mine Rescue

01. All employees (underground and surface) should be given first-aid training as soon as possible after being employed.

02. If feasible, additional first-aid training should be given to all employees annually.

*03. Adequate first-aid material should be provided on the surface and underground and kept in clean, usable condition.

04. At least 10 sets of oxygen breathing apparatus and at least 6 gas masks and necessary accessories should be available in each mining district for use in case of mine fire or explosion. This equipment should be available at centrally located rescue stations owned by the State or operators in the district, or be owned by individual companies. This equipment should be readily available at all times.

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05. When training facilities are available, at least 12 men should be trained in mine rescue work at mines having more than 100 employees; mines having 100 employees or less should have a proportionately lesser number trained.

06. Additional mine rescue training should be given monthly if training facilities are available.

07. Mine officials should take an advanced mine rescue course when such course is available.

08. Self-rescuers should be readily available to all underground employees.

09. If self-rescuers are available, employees should be trained in their use. Self-rescuer cases should be maintained in airtight condition.

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